PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

A Method of Making Moulded Plastics Containers and Apparatus for Carrying Out Such Method

We, FMC CORPORATION, of 1617 Pennsylvania Boulevard, Philadelphia, Pennsylvania, United States of America, a corporation organized and existing under the laws of the State of Delaware, one of the United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns a method of making moulded plastics containers and apparatus for carrying out such method. More particularly, this invention relates to an improved method and apparatus for attaching preformed elements or fixtures (hereinafter called "preformed elements") to containers during the formation thereof, and to moulded containers so produced.

It is conventional in the art to form containers and other hollow articles by expanding a gob or closed tube of expandable plastics material within a desirably shaped mould. In a separate operation, containers formed in this manner are often provided with preformed elements, such as spouts or caps, as by means of adhesives or separate fasteners. The mode of attaching these preformed elements, however, usually demands greater care and accuracy during the moulding operation, entails added operations and material costs, and may often involve some sacrifice in the structural integrity of the container itself.

According to the present invention there is provided a method of forming a hollow article of film-forming plastics material, including the steps of delivering a flowable mass of the film-forming material in the form of a tube or a gob into a mould, expanding the mass against the walls of the surrounding mould, causing or permitting the film-forming material of the expanded mass to set and severing the expanded film-forming material from its source of supply, such method also including the step of engaging a preformed element having undercut portions with an end of the tube of the flowable mass or the expanded gob so that the film-forming material first flows into the preformed element and then outwardly under and into engagement with the undercut portions of the preformed element and thereby interlockingly attaches the preformed element to the hollow article.

In one embodiment of the method, the preformed element is first positioned close to an annular extrusion means so that the film-forming material flows into the undercut portions thereof. This preformed element is then moved away from the extrusion means concomitantly with the continued delivery of the flowable film-forming material so that a tubular mass thereof is provided within the surrounding mould. In another embodiment, a gob or closed tube of plastic film-forming material is suspended within a desirably shaped mould, and such film-forming material is expanded as a seamless envelope against the internal walls of the mould and into engagement with a preformed element which is supported within such mould. The containers moulded by the method of the present invention may be filled with a flowable material and sealed while still remaining in the mould or alternatively, they may be released and stored or filled in a separate and independent operation.

The mass of plastic film-forming material which is initially delivered into the mould cavity may include an amount necessary for forming the entire container. Alternatively, this initial mass may be supplemented with

additional film-forming material supplied continuously and concomitantly with the expansion thereof into a container form.

Expansion of the plastics film-forming material may be achieved by means of air or other gas which is non-reactive with the particular film-forming material employed, or by means of a vacuum applied through the walls of the mould or by a flowable material which is being packaged or by a combination of these procedures. If desired, the expanding or inflating medium may be in a heated condition when delivered into the gob of film-forming material to prevent premature setting thereof.

In the embodiment of the invention wherein an annular mass of flowable film-forming material is extruded, the apparatus comprises, according to another aspect of the invention means for supplying the mass of film-forming material, mould sections providing a mould cavity of a desired shape whereinto the mass is supplied, means for expanding the mass against the walls of the mould cavity, means serving both to sever the expanded film-forming material from the supply means and to seal the film-forming material thus severed, a pillar for supporting a preformed element, the said pillar cooperating with the mould sections to provide said cavity, and means for moving the pillar towards and away from the supply means.

The apparatus may also include means for filling the resulting hollow article or container with a flowable material which is to be packaged while the container remains in the mould cavity, as more fully described hereafter.

In the resulting containers, the preformed element forms part of the container walls or body which is itself of seamless and unitary construction. The preformed element and container body are mechanically interlocked so that these parts may be readily separated from each other yet are connected together by a fluid-tight joint.

The preformed elements which are attached to the containers may be formed of metal, plastics or any other suitable materials which are capable of withstanding the conditions employed during the moulding operation. Except for the presence of undercut or re-entrant portions, as heretofore mentioned, the particular shape, structure and function of the preformed element is not critical for satisfactory practice of the present invention. For example, such preformed elements may consist of pouring spouts, caps or closures, advertising materials and container handles.

In one embodiment of the present invention, the container which is formed includes a preformed spout having external serrations for retaining a cap, tube, or perhaps a baby feeding nipple. In another embodiment, the attached element is itself a preformed container which includes re-entrant portions for interlocking the same to a plastics container during the molding of the latter. In a still further embodiment, the moulded container includes a preformed metal ring having a series of projections or teeth which serve to cut the container when the ring and container are turned relative to each other.

The container of the present invention may be made from a wide variety of materials which may be rendered plastic or in a flowable condition. Preferred types include the synthetic linear polymers of thermoplastic character and the elastomeric types. Of course, the selection of any particular material depends upon the character of the material which is to be packaged in the finished container. Thus, polyvinyl acetate, polyvinyl acetals, polyvinyl alcohols and neoprene, especially the latter two types, are highly advantageous when packaging oils, especially of the hydrocarbon type. Polyvinyl acetate, polyvinyl chloride, related copolymers of these two monomers, and polyethylene are, on the other hand, particularly adapted for packaging of aqueous liquids.

The film-forming material may be converted into a flowable mass or gob by fusion or by the incorporation of plasticizers or solvents capable of dissolving or dispersing the material. Thus, any of the thermoplastic materials may be heated to fusion, after which the expanding or inflating medium may be introduced into a tubular mass thereof, preferably at the same temperature as the fused material. If necessary, the temperature of fusion may be lowered by the incorporation of a plasticizer either of solid or liquid character. When plasticizers or solvents are incorporated into the plastic material to form the gob, the plasticizer or solvent is preferably non-reactive with the expanding medium. The cooling of the fused plastic mass, with or without plasticizers, is effected as the expanded envelope strikes the walls of the mould where it is set into a desired shape. Volatile solvents may be employed for dissolving or dispersing the film-forming material so that the tube or gob may be formed at room temperature and expanded, with the setting or coagulation of the expanded envelope occurring by volatilization of the solvent after expansion thereof against the mould walls. Known solvents and plasticizers may be employed, the selection depending upon the particular film-forming material to be used. Thus acetone or dioxane may be used for vinyl acetate or copolymers of vinyl acetate or vinyl chloride or acrylonitrile. The concentration of the film-forming material, when a solution thereof is used, is preferably as great as possible and is limited only by the necessity that the plastic mass be capable of expanding under the pressure of the expanding medium, yet be

of a reasonably viscous coherent plastic character which is capable of supporting its own weight.

In order that the invention may be more readily understood, several embodiments of the same will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a vertical section taken through the moulding apparatus of one embodiment of the present invention and illustrating the positions assumed by the various parts thereof at the start of moulding operations;

Figure 2 is a view similar to that of Figure 1, illustrating the positions of the parts of the apparatus during an intermediate stage of an embodiment of the method of the present invention;

Figure 3 is a view similar to Figure 2, showing the parts of the apparatus during a final stage of the method of the present invention;

Figure 4 is a side view of a container formed in accordance with the present invention, with a portion thereof shown in section;

Figure 5 is a vertical section taken through a moulding apparatus employed in the practice of another embodiment of the present invention;

Figure 6 is a partial side view of a container formed by the apparatus shown in Figure 5 with a portion thereof being shown in section;

Figure 7 is a view similar to Figure 6 of another embodiment of a container produced according to the present invention;

Figure 8 is a view similar to that of Figures 6 and 7 of still another embodiment of the present invention;

Figure 9 is a side view of the container of Figure 8 in an opened position; and

Figure 10 illustrates a portion of the container shown in Figure 9, as viewed along the line X—X.

Referring to Figure 1 of the drawing, the apparatus of the present invention includes an extruder or die 11, a pillar 13 and cooperating mould sections 15 and 17. The extruder 11 is of known construction and includes a pair of spaced concentric die members 19 and 21. The die member 19 is connected to a supply of flowable or plastic film-forming material, while the member 21 is similarly connected to a suitable pump or pressurized tank for delivering an expanding or inflating medium, such as air, in accordance with a predetermined flow pattern. Telescoped within the die member 21 is a filling tube 23 which is connected to a supply of flowable material which is to be packaged. The tube 23 is preferably supported by suitable reciprocating means, such as a rack and pinion, not shown, so as to permit the tube 23 to be moved relative to the extruder. In addition, a pair of blades 25 are slidably supported by guides 27 for reciprocating movement across the end of the die member 19, as indicated by arrows 29.

The pillar 13 is adapted to be reciprocated toward and away from the extruder 11, as indicated by arrows 31 and 33. Similarly, the mould sections 15 and 17 are mounted by suitable means, not shown, for lateral movement toward and away from each other as indicated by arrows 35 and, together with the pillar 13, provide a cavity 37 of desired configuration. The pillar 13 includes a recess 39 for receiving a preformed element or fixture, such as a container closure shown at 41, and an annular projection 43 which is adapted to seat within correspondingly shaped recesses 45 formed in the mould sections 15 and 17.

In practicing the method of the present invention with the above described apparatus, a closure 41 or other preformed element is first positioned within the recess 39 of the pillar 13 with its undercut (or re-entrant) portions 47 being exposed. The pillar 13 is then elevated into contact with the extruder 11, as shown in Figure 1, after which plastic or flowable film-forming material, indicated at 49, is supplied through the die member 19. The film-forming material which is first delivered engages with the inside surface of the closure and then flows radially outwardly under and into the undercut portions thereof. If necessary, the internal surface of the closure 41 may be pretreated with a suitable material, such as a silicone, to prevent adhesion of the film-forming material which engages therewith.

Concomitantly with continuous extrusion of the flowable film-forming material, the pillar 13 is moved to its lowermost position and locked in place by the mould sections 15 and 17, as shown in Figure 2. The tubular mass 51 of film-forming material which is located within the mould cavity 37 is then expanded against the internal walls of the mould sections, as by air delivered through the die member 21.

The expanded film-forming material may then be set, as by circulating chilled fluids through or against the mould sections to form a container body 53. While the film-forming material of the container body is still in a flowable or plastic condition, the blades 25 are urged toward each other to thereby complete the formation of a container 53, which is shown in inverted position in Figure 3. The blades 25 may be heated to encourage flow of the film-forming material during container closing and, if desired, the container may be filled with a flowable material 57 which is to be packaged, as by means of the tube 23, prior to the final sealing operation.

It will be noted that, as the blades 25 move across the die member 19 to seal the

finished container 53, the film-forming material which has been extruded is cleanly severed from that remaining in the die member 19. As a result, the film-forming material which is subsequently extruded will issue from the die part 19 as an annular or open-ended tube. The filled and inverted container 53 may be ejected from the apparatus merely by moving the mould sections 15 and 17 away from each other.

The tubular mass of film-forming material which is initially delivered into the mould cavity may include the amount necessary for completing the formation of the entire container 53. Alternatively, the initially supplied mass of film-forming material may be just sufficient to start the formation of such container and may be continuously replenished concomitantly with the expansion thereof to provide a container having a desired wall thickness. Further, in lieu of inflating such mass of film-forming material with air, expansion may be achieved by the flowable material which is intended to be packaged, or by a combination of such expanding mediums.

In the finished container 53, as shown in Figure 4, the undercut or re-entrant portions of preformed closure 41 are securely interlocked with the container body to provide for fluid-tight seal. The preformed closure can be repeatedly removed by and reapplied to the container body, in the same manner as conventional snap-type covers, without any significant sacrifice in the strength and seal of the joint provided between the closure or container body.

The apparatus shown in Figure 5 is similar to that of Figures 1—3 and like numerals therein designate like parts operating in the same manner. In this embodiment, mould sections 15 and 17 cooperate with a mould section 13^1 to provide the cavity 33 of desired configuration. The mould section 13^1 includes a recess 55 for receiving a preformed element, such as a container spout shown at 58, and an annular projection 43^1 which is adapted to seat within correspondingly shaped recesses 45 formed in the mould sections 15 and 17. As indicated by arrow 33^1, the mould section 13^1 is adapted to be reciprocated vertically relative to a fixed article ejecting ring 65.

In practicing the method of the present invention with the latter apparatus, the spout 58 or other preformed element is first positioned within the recess 55 of the mould section 13^1 after which the mould sections 15 and 17 are urged toward each other and against the mould section 13^1. As shown in Figure 5, the mould sections 15 and 17 lock the mould sections 13^1 against vertical movement and provide the desired mould cavity 37.

Plastic or flowable film-forming material, indicated at 49 is then supplied through the die member 19 to form a gob thereof across the extruder 11, as shown in broken lines at 49^1. An expanding medium, such as air, is then delivered through the die member 21 to provide for continuous expansion of the gob of film-forming material into the form of a seamless envelope 53 which engages with the exposed surfaces of the preformed spout 58, which flows into and about the undercut portions 62 and interlocks therewith as such expanded film-forming material is subsequently set to form a container body 53.

The blades 25 are urged toward each other while the film-forming material 49 is still in a plastic or flowable condition to complete the formation of a container and sever the same from the film-forming material which remains in the die member 19. The blades 25 may be heated to encourage flow of the film-forming material during container closing and, if desired, the container may be filled with a flowable material which is to be packaged, as by means of the tube 23, prior to the final sealing operation. It will be noted that, during severance of the finished container, the tube of film-forming material remaining in the die member 19 is closed, as shown at 59, and thus prepares the same for the next container forming cycle. The filled container is removed from the apparatus by first moving the mould sections 15 and 17 away from each other and then lowering the mould section 13^1 until the container engages with the ejector ring 65.

In the finished container, the preformed spout 58 is securely interlocked with the container body. It will be noted that, while the film-forming material flowed over and into the undercut portions 62 of the spout 58 during the expansion thereof, the container body is of continuous, unbroken and fluid construction in the area in which such spout 58 is attached. Actually, the container body extends across and seals the discharge opening 61 of the preformed spout 58 so that such body portion must be ruptured before the container contents may be removed. As illustrated, the container spout 58 may be provided with external threads or serrations 63 which serve to retain in place a cap 65 or other suitable means, as for example a baby feeding nipple. If desired, the cap 65 may be provided with a pin 67 for use in puncturing the container body 55 in the area of the spout discharge opening 61.

It will be understood, of course, that the method of the present invention may be employed for embedding or attaching a variety of different preformed elements to containers during the moulding thereof. In the embodiment shown in Figure 7, the preformed element consists of a container 67 which is interlocked by means of an upstanding lip

69 of the preformed container 67, disposed at an acute angle to the adjacent container surface so as to provide re-entrant portions 71 with which the moulded container interlocks.

In a still further embodiment of the invention, a preformed ring 73 is interlocked with the body portion 75 of a container 77, using the method as described above. The preformed ring 73 is formed with a plurality of flat, inwardly directed, pointed projections 79 which serve to sever the upper portion of the container body when such ring is rotated relative thereto. As shown in Figure 9, the severed portion of the container body remains interlocked with the preformed ring 73 and they together serve as a replaceable container cap.

In practicing the above described method in forming the container 77, it has been found that the plastic film-forming material which is employed readily flows over and around the pointed projections of the ring 73. Thus, there is no damage to the continuous and unbroken construction of the container body nor any significant reduction in the container wall thickness at these areas.

WHAT WE CLAIM IS:—

1. A method of forming a hollow article of film-forming plastics material, including the steps of delivering a flowable mass of the film-forming material in the form of a tube or a gob into a mould, expanding the mass against the walls of the surrounding mould, causing or permitting the film-forming material of the expanded mass to set and severing the expanded film-forming material from its source of supply, such method also including the step of engaging a preformed element having undercut portions with an end of the tube of the flowable mass or the expanded gob so that the film-forming material first flows into the preformed element and then outwardly under and into engagement with the undercut portions of the preformed element and thereby interlockingly attaches the preformed element to the hollow article.

2. A method according to claim 1, wherein the film-forming material is delivered into the mould in the form of a tubular mass, wherein the film-forming material flows under and into the undercut portions of the preformed element before the tubular mass is expanded.

3. A method according to claim 2 wherein an open end of the tubular mass is engaged with the preformed element and flows radially into the undercut portions thereof to interlock therewith.

4. A method according to claim 2 or 3 wherein the flowable tubular mass is delivered from an extrusion die, and wherein the preformed element is moved away from the die while the tubular mass is concomitantly extruded therefrom.

5. A method according to claim 1, wherein the film-forming material is delivered into the mould in the form of a gob, and wherein the gob is expanded into a seamless, unbroken envelope against the internal walls of the mould and the exposed undercut portions of the preformed element.

6. A method according to any one of the preceding claims, wherein the flowable mass of film-forming material is expanded by an inert gas.

7. A method according to any one of claims 1 to 5 wherein the flowable mass of film-forming material is expanded by a fluid material which is to be packaged in the hollow article and is sealed after expansion.

8. A method according to claim 5, wherein the said inert gas is displaced by a fluid material which is to be packaged in the hollow article and the film-forming material is sealed after expansion.

9. A method according to any one of the preceding claims, wherein the film-forming material is thermoplastic and is set by cooling.

10. Apparatus for forming a hollow article according to claim 1, comprising means for supplying the mass of film-forming material, mould sections providing a mould cavity of a desired shape whereinto the mass is supplied, means for expanding the mass against the walls of the mould cavity, means serving both to sever the expanded film-forming material from the supply means and to seal the film-forming material thus severed, a pillar for supporting a preformed element, the said pillar cooperating with the mould sections to provide said cavity, and means for moving the pillar towards and away from the supply means.

11. A moulded container formed of film-forming plastics material made according to the method of any one of claims 1 to 9 and/or using the apparatus of claim 10, said container having a body of seamless and unitary construction and an independent preformed element attached to the container body, the preformed element having undercut portions into and under which extend corresponding portions formed in the container body whereby the preformed element is interlockingly attached to the container body without damaging its seamless and unitary construction.

12. A moulded container according to claim 11, wherein the preformed element is a preformed container removable from the moulded container body without damaging its seamless and unitary construction.

13. A moulded container according to claim 10, wherein the preformed element is a tubular spout having a discharge opening

and the interlocking portions of the container body are continuous and unbroken.

14. A moulded container according to claim 10, wherein the preformed element is a ring attached to the outside undercut portions, the projections having cutting edges adapting the same to sever the seamless container body when the ring is turned relative thereto.

15. A moulded container according to claim 14, wherein the ring encircles a portion of the side wall of said container body and extends over at least a portion of the adjacent end wall thereof.

16. A moulded container according to claim 14 or 15, wherein the projections are flat and pointed.

17. A method of forming a hollow article substantially as hereinbefore described with reference to Figures 1 to 4 of the accompanying drawings.

18. A method of forming a hollow article substantially as hereinbefore described with reference to Figures 5 and 6 of the accompanying drawings.

19. A method of forming a hollow article substantially as hereinbefore described with reference to Figure 7 of the accompanying drawings.

20. A method of forming a hollow article substantially as hereinbefore described with reference to Figures 8, 9 and 10 of the accompanying drawings.

21. Apparatus for forming hollow articles substantially as hereinbefore described with reference to and as shown in Figures 1 to 3 of the accompanying drawings.

22. Apparatus for forming hollow articles substantially as hereinbefore described with reference to and as shown in Figure 5 of the accompanying drawings.

23. A moulded container substantially as hereinbefore described with reference to and as shown in Figure 4 of the accompanying drawings.

24. A moulded container substantially as hereinbefore described with reference to and as shown in Figure 6 of the accompanying drawings.

25. A moulded container substantially as hereinbefore described with reference to and as shown in Figure 7 of the accompanying drawings.

26. A moulded container substantially as hereinbefore described with reference to Figures 8, 9 and 10 of the accompanying drawings.

27. A moulded container when made by the method of any one of claims 1 to 9 and/or using apparatus according to claim 10.

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheets 1 & 2

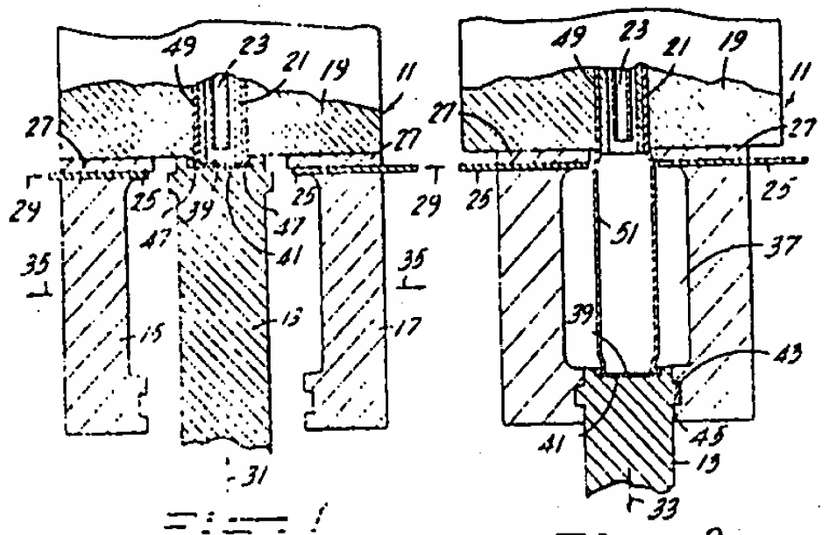

Fig. 1

Fig. 2

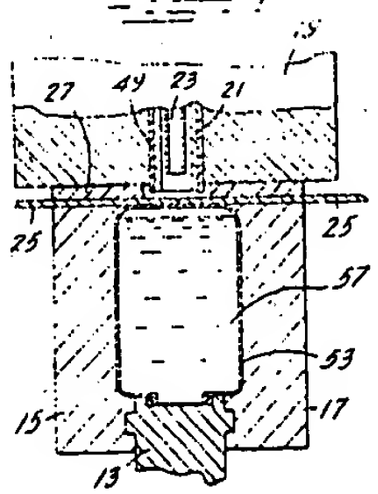

Fig. 3

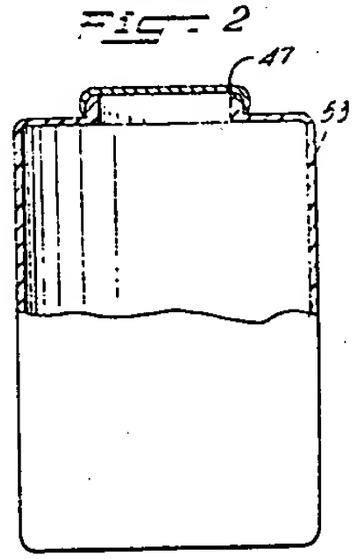

Fig. 4

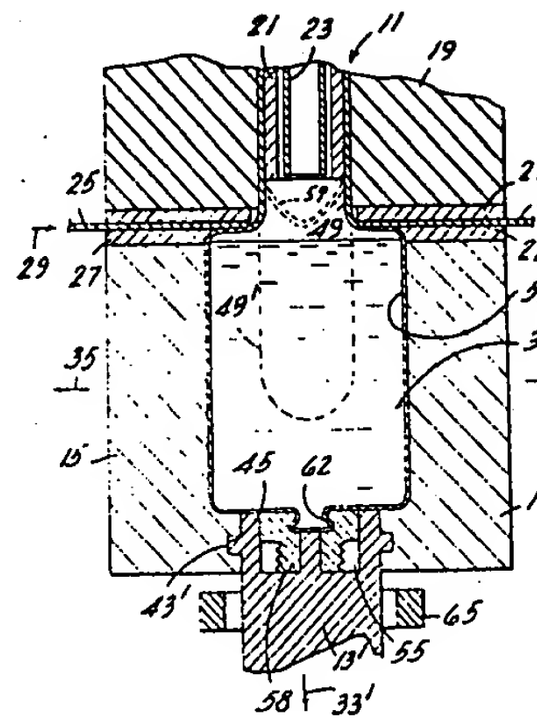

Fig. 5

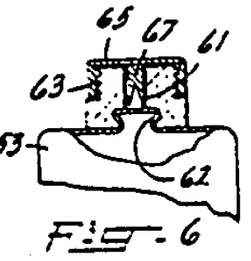

Fig. 6

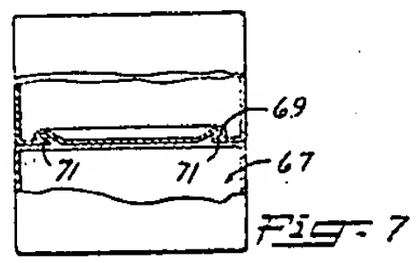

Fig. 7

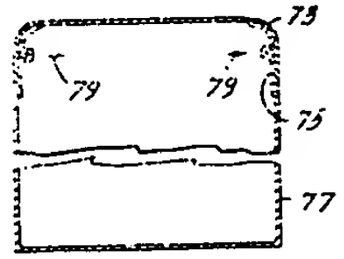

Fig. 8

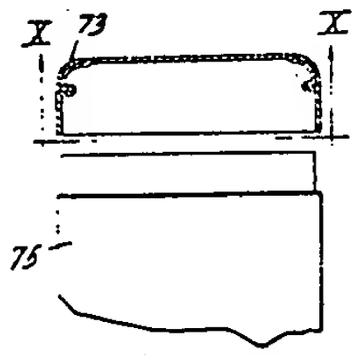

Fig. 9

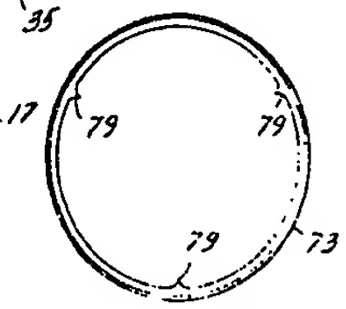

Fig. 10